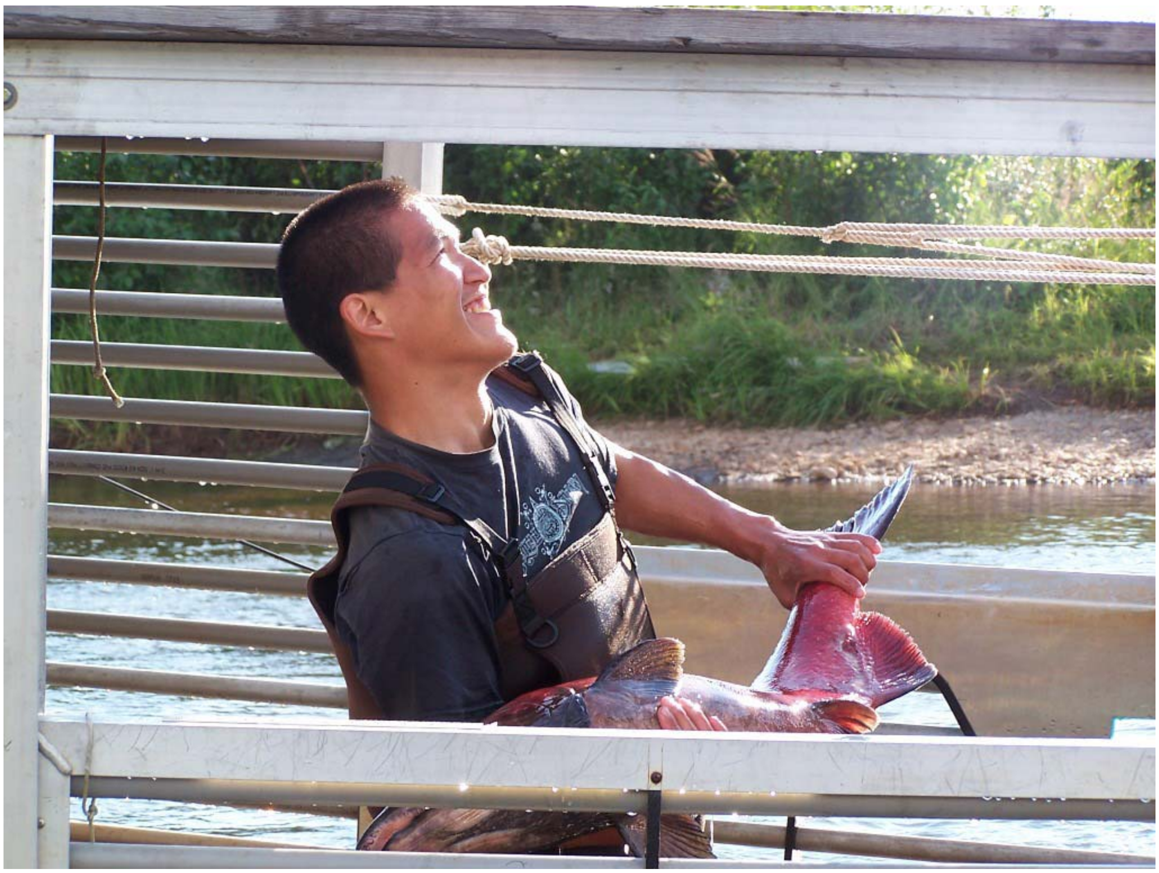
U.S. Fish & Wildlife Service

Abundance and Run Timing of Adult Pacific Salmon in the Kwethluk River, Yukon Delta National Wildlife Refuge, Alaska, 2004

Alaska Fisheries Data Series Number 2005–7



Kenai Fish and Wildlife Field Office
Kenai, Alaska
April 2005

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Tim Roettiger, Frank Harris, and Ken C. Harper

Abstract

From June 25 to September 10, 2004, the U.S Fish and Wildlife Service, assisted by the Organized Village of Kwethluk, operated a resistance board weir to collect abundance, run timing, and biological data from salmon returning to spawn in the Kwethluk River, a tributary to the lower Kuskokwim River. Information from this weir was used by the in-season managers to manage the commercial and federal subsistence fisheries on the Yukon Delta National Wildlife Refuge. A total of 38,646 chum *Oncorhynchus keta*, 28,604 Chinook *O. tshawytscha*, 3,491 sockeye *O. nerka*, 3,053 pink *O. gorbuscha*, and 64,216 coho *O. kisutch* salmon were counted through the weir. Peak weekly passage, by species, was as follows: June 27 to July 3 for sockeye, June 27 to July 3 for Chinook, July 18 to July 24 for chum, August 8 to August 14 for pink, and August 29 to September 4 for coho salmon. Age, sex, and length information was collected for all species except pink salmon.

Introduction

The Kwethluk River, a lower Kuskokwim River tributary located on the Yukon Delta National Wildlife Refuge (Refuge), provides important spawning and rearing habitat for chum *Oncorhynchus keta*, Chinook *O. tshawytscha*, sockeye *O. nerka*, pink *O. gorbuscha*, and coho *O. kisutch* salmon (Figure 1) (Alt 1977; U.S. Fish and Wildlife Service 1992). Adult salmon returning to the Kwethluk River migrate 131 river kilometers (rkms) through the lower Kuskokwim River before reaching the mouth of Kwethluk River, and then up the Kwethluk River as many as 160 rkms to reach spawning grounds. In the lower Kuskokwim River, salmon pass through one of Alaska's most intensive subsistence fisheries (Burkey et al, 2001; U.S. Fish and Wildlife Service 1988).

The Alaska National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved in their natural diversity within the Refuge; that international treaty obligations are fulfilled; and that subsistence opportunities for local residents be maintained. Salmon escapement studies for the Kuskokwim River tributaries on the Refuge are ranked as priorities in the Refuge Fishery Management Plan (U.S. Fish and Wildlife Service 1992). Compliance with ANILCA mandates, however, are not ensured when reliable data regarding fish stocks originating within the Refuge are not available.

Adequate escapements to individual tributaries and main stem spawning areas are required to maintain genetic diversity and sustainable harvests, but management is complicated by the

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mixed stock nature of the Kuskokwim River fishery. Managers attempt to distribute the catch over time to avoid overharvesting of individual stocks, since each may have a distinct migratory timing (Mundy 1982). Stocks or species returning in low numbers or early and late portions of runs may be overharvested incidentally during the intensive harvesting of abundant stocks. Escapement data are lacking on many of these individual stocks in the Kuskokwim River drainage and are needed for more precise management.

Under guidelines established in the sustainable salmon fisheries policy 5AAC.39.222, the Alaska Board of Fisheries designated Kuskokwim River chum and Chinook salmon as yield concerns. This designation was based upon the continued inability, despite specific management measures, to maintain expected yields, or have stable surpluses above the stocks escapement needs for three of the past five years. Based upon this designation, the salmon fishery in the Kuskokwim River drainage is managed under the Kuskokwim River Salmon Rebuilding Management Plan (Rebuilding Plan) (Ward et al. 2003: Bergstrom and Whitmore 2004). The portion of the Kuskokwim River within the boundaries of the Yukon Delta National Wildlife Refuge was under both the Rebuilding Plan and the Federal Subsistence Fishery Management Program.

The Alaska Department of Fish and Game (Department), the U.S. Fish and Wildlife Service (Service) and the Kuskokwim River Salmon Management Working Group (Working Group) work together to achieve the goals of both the Rebuilding Plan and the Federal Subsistence Fishery Management Program. The Rebuilding Plan was established to provide management guidelines resulting in the sustained yield of salmon stocks large enough to meet the following goals: (1) To manage for the achievement of established escapement goals, (2) To meet the amounts necessary for subsistence, and (3) To allow for a commercial fishery on harvestable surplus after escapement and subsistence needs are projected to be met (Ward et al. 2003). In addition to the goals set by the Department, the Service, and the Working group, ANILCA mandates that salmon populations and their habitats be conserved in their natural diversity within the Refuge.

In accordance with ANILCA mandates, the U.S. Fish and Wildlife Service (Service) initiated a three-year study of the Kwethluk river in 1991 to: (1) enumerate adult salmon; (2) describe the run timing for chum, Chinook, sockeye, pink, and coho salmon returns; (3) estimate the age, sex, and length composition of adult chum, Chinook, sockeye, and coho salmon populations; and (4) identify and count other fish species passing through the weir. High water precluded the installation and operation of the weir in 1991, and the weir was operated only in 1992.

In September 1992, village leaders passed resolutions opposing the weir, consequently the Service discontinued weir operations. In 1996, the Association of Village Council Presidents (AVCP) initiated a counting tower project, which operated through 1999. Complete counts for chum, Chinook, and sockeye salmon were obtained only in 1996 and 1997 because high water delayed operations until late July in 1998 and 1999. In all years of the tower project, high water prevented operations beyond mid August; therefore, few data exist regarding the abundance and run timing of coho and pink salmon for those years. Additionally, sampling for age, sex, and length information was unsuccessful in 1996 and 1997, and sampling was discontinued in successive years (Cappiello and Sundown 1998; Cappiello and Chris 1999). No comprehensive sampling data exist for the years of tower operation.

On October 1, 1999, the Secretaries of Interior and Agriculture expanded federal subsistence fisheries management in Alaska under Title VIII of ANILCA. To meet this management responsibility, the Federal Subsistence Board established the Fishery Resource Monitoring Program to gather information on fish stock status and trends and subsistence harvest patterns. This program funds studies to gather, analyze, and report information needed to manage subsistence fisheries in both the Kwethluk and Kuskokwim rivers. Because of the importance of the Kwethluk River, this weir project was one of the first projects funded under this program in 2000. The Kenai Fish and Wildlife Field Office (KFWFO) and the Organized Village of Kwethluk (OVK) have cooperatively conducted this project during the past five years (2000-2004).

Study Area

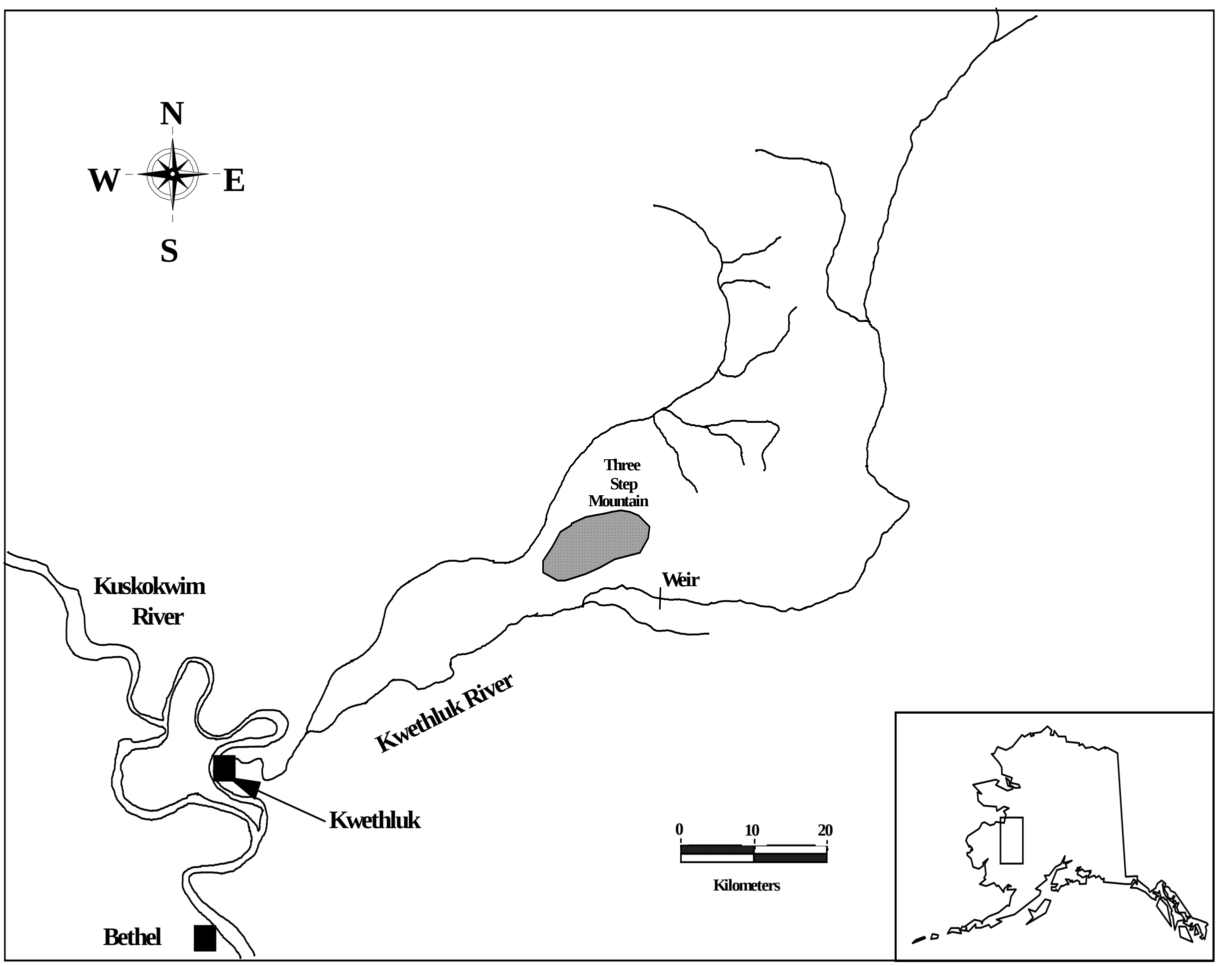

FIGURE 1. Location of the Kwethluk River weir.

The Kwethluk River is in the lower Kuskokwim River drainage (Figure 1). The region has a subarctic climate characterized by extremes in temperature. Temperatures range from summer highs near 15˚C to average winter lows near -12˚C (Alt 1977). Average yearly precipitation is approximately 50 cm with the majority falling between June and October. The rivers generally become ice-free in the slow moving sections by early May and freeze up in late November. The Kwethluk River originates in the Kilbuck Mountains, flows northwest approximately 222 km, and drains an area of about 3,367 km^2. Braiding and gravel substrates are found in the middle section of the river, where the weir was placed. Below the middle section, the lower 47 km consists of a deeper, muddy-bottomed channel averaging 53 m in width (Alt 1977). Turbid water conditions that also are characteristic of this lower section are the result of active stream cutting on tundra banks.

Objectives

1. Enumerate daily passage of adult chum, Chinook, sockeye, pink, and coho salmon and resident fish species through the weir.
2. Describe the run-timing and proportional daily passage of chum, Chinook, sockeye, pink, and coho salmon through the weir.
3. Estimate the weekly sex and age composition of chum, Chinook, and coho salmon such that the simultaneous 90% confidence intervals have a maximum width of 0.20.
4. Estimate the mean length of chum, Chinook, and coho salmon by sex and age.
5. Enumerate the chum, Chinook, sockeye, pink, and coho salmon carcasses that wash down onto the weir each day.
6. Monitor passage of chum, Chinook, sockeye, and coho salmon tagged in the middle Kuskokwim River mark recapture study.

Methods

Weir Operations

A resistance board weir (Tobin 1994) spanning 56 m was installed in the Kwethluk River (62°29.38' N, 161°05.54’W) approximately 88 rkm upstream from the Kuskokwim River and 43 air-km east of Kwethluk, Alaska (Figure 1). This location is approximately 2.4 rkm downstream from the 1992 weir site described by Harper (1998). The weir was moved downstream to this section of river in 2000 due to a change in the channel morphology at the old location. A staff gauge was installed upstream of the weir to measure daily water levels. Staff gauge measurements were correlated to correspond with the average water depth across the river channel at the upstream edge of the weir. Water temperatures were collected daily at the site, June 25 through September 10 using a Hobo© recording temperature recorder.

One live trap and one counting passage way were installed to facilitate sampling and efficient fish passage during varying river stage heights. All fish were enumerated to species as they passed through the live trap or counting passage way (Harper 1998). Salmon and resident species that did not pass through these areas, but escaped upstream through the gaps between the pickets were not counted. Picket spacing is 4.8 cm, wider than the 3.5 cm spacing used in 1992. Panels with wider picket spacing were designed to remain functional during greater water flow and allow passage of smaller pink salmon between pickets. Fish were passed and counted intermittently between 0001 hours and midnight each day. The duration of counting sessions varied depending on the intensity of fish passage through the weir and was recorded to the nearest 0.25 hour at each counting station.

The weir was inspected for holes and cleaned daily. An observer outfitted with snorkeling gear checked weir integrity and substrate conditions. Cleaning consisted of raking debris from the upstream surface of the weir or walking across each panel until it was partially submerged, allowing the current to wash accumulated detritus downstream.

Biological Data

Sample weeks, or strata, began on Sunday and ended the following Saturday. However, a partial week of weir operation shortened the last strata. Sampling generally commenced near the beginning of the week, and an effort was made to obtain a weekly quota of 200 chum, 210 Chinook, and 200 sockeye salmon in as short a period (1-3 days) as possible, to approximate a pulse or snapshot sample (Geiger et al. 1990). The sample objective for coho salmon was 210 for the season with samples from the early, middle and late part of the run. All target species within the trap were sampled to prevent bias.

Fish sampling consisted of measuring length, determining sex, collecting scales, and then releasing the fish upstream of the weir. Length was measured from mideye to the fork of the caudal fin and rounded to the nearest 5mm. Sex was determined by observing external characteristics, including presence of ovipositor or gametes. Scales were removed from the preferred area for age determination (Koo 1962, Mosher 1968). One scale was collected from each chum and sockeye salmon, and four from each Chinook and coho salmon. Scale impressions were made on cellulose acetate cards using a heated scale press and examined with a microfiche reader. A Department biologist determined age and reported results according to the European Method (Koo 1962).

Characteristics of fish passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum m, the proportion of species i passing the weir that are of sex j and age k (p_{ijkm}) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}},$$

where n_{ijkm} denotes the number of fish of species i, sex j, and age k sampled during stratum m and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species i sampled in stratum m. The variance of $\hat{p}_{ijkm}$ was estimated as

$$\hat{v}\left(\hat{p}_{ijkm}\right) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right) \frac{\hat{p}_{ijkm}\left(1 - \hat{p}_{ijkm}\right)}{n_{i++m} - 1},$$

where N_{i++m} denotes the total number of species i fish passing the weir in stratum m. The estimated number of fish of species i, sex j, age k passing the weir in stratum m (N_{ijkm}) is

$$\hat{N}_{ijkm} = N_{i++m}\,\hat{p}_{ijkm},$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijkm}\right) = N_{i++m}^2\,\hat{v}\left(\hat{p}_{ijkm}\right).$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right) \hat{p}_{ijkm}$$

with estimated variance

$$\hat{v}\left(\hat{p}_{ijk}\right) = \sum_m \left(\frac{N_{i++m}}{N_{i+++}}\right)^2 \hat{v}\left(\hat{p}_{ijkm}\right).$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ijk} = \sum_m \hat{N}_{ijkm},$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijk}\right) = \sum_m \hat{v}\left(\hat{N}_{ijkm}\right).$$

If the length of the r^{th} fish of species i, sex j, and age k sampled in stratum m is denoted x_{ijkmr}, the mean length of all such fish (μ_{ijkm}) was estimated as

$$\hat{\mu}_{ijkm} = \left(\frac{1}{n_{ijkm}}\right)\sum_r x_{ijkmr},$$

with corresponding variance estimator

$$\hat{v}\left(\hat{\mu}_{ijkm}\right) = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}}\right) \frac{\sum_r \left(x_{ijkmr} - \hat{\mu}_{ijkm}\right)^2}{n_{ijkm}\left(n_{ijkm} - 1\right)}.$$

The mean length of all fish of species i, sex j, and age k (μ_{ijk}) was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\mu}_{ijk} = \sum_m \left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}}\right) \hat{\mu}_{ijkm}.$$

An approximate estimator of the variance of $\hat{\mu}_{ijk}$ was obtained using the delta method (Seber 1982).

$$\hat{v}\left(\hat{\mu}_{ijk}\right) = \sum_m \left\{ \hat{v}\left(\hat{N}_{ijkm}\right) \left[\frac{\hat{\mu}_{ijkm}}{\sum_x \hat{N}_{ijkx}} - \sum_y \frac{\hat{N}_{ijky}\ \hat{\mu}_{ijky}}{\left(\sum_x \hat{N}_{ijkx}\right)^2} \right]^2 + \left(\frac{\hat{N}_{ijkm}}{\sum_x \hat{N}_{ijkx}}\right)^2 \hat{v}\left(\hat{\mu}_{ijkm}\right) \right\}$$

A two-sample t-test for samples of unequal variance (Microsoft Office Excel 2003) was used to test the hypothesis that male and female fish of age k have equal mean lengths ($\alpha = 0.05$). Data were pooled across all strata and treated as one sample to compare lengths.

Estimates of missed salmon passage

For days when high water or damage to the weir prevented accurate counts, estimates were made using percent passage data from previous years with complete data. The passage for the jth day with missing data was estimated as:

$$\hat{n}_j = \left[\frac{\sum_{i=1}^{D} \theta_i n_i}{1 - \sum_{i=1}^{D} \theta_i p_i} \right] p_j,$$

where

n_i = weir passage on day i,

p_i = proportional passage on day i based on historical data,

θ_i = an indicator variable defined as 1 if passage was observed on day i, 0 otherwise, and

D = number of days in the season.

Carcass counts

Post-spawn salmon and carcasses of dead salmon that washed up on the weir were counted by species and passed downstream. Each crew member was responsible for counting carcasses when they took over a counting shift and when they left a shift, resulting in the weir being cleaned of carcasses at least every 4 hours.

Mark-recapture tag recovery

The Kwethluk River weir was used as a platform for collecting data from the mainstem Kuskokwim River mark recapture study. Observers were instructed to gather information on recaptured tag numbers, and total tags by color observed, and look for a secondary mark. Recaptured tagged and total tagged fish were used in generating abundance and run timing estimates. Fish sampled for age, sex, and length were examined for a secondary mark that is used to estimate tag loss (Kerkvleit et al. 2004).

Results

Weir Operations

Similar to past years, the weir panels were installed in April to take advantage of low water conditions. In June the trap was installed and the weir became operational on June 25, 2004. No major difficulties were encountered during the operational period with the exception of a small hole in the weir that allowed some fish to pass uncounted on July 2 and 22. Estimates for missed passage were generated. Counting terminated on September 10, 2004. Water level and temperature data were collected on a daily basis (Appendix 1).

Biological Data

Chum Salmon - A total of 38,646 chum salmon passed through the weir from June 25 to September 10, 2004. Peak weekly passage (N = 7,900) occurred during the week of July 18 to July 24 (Figure 2). Median-cumulative passage occurred on July 14 (Appendix 2). Gillnet marks were observed on 1% (N = 393) of the chum salmon passing through the weir.

Four age groups were identified from scale samples (0.2, 0.3, 0.4, 0.5). For males, the predominant age group was 0.4 (42%). For females, the predominant age group was 0.3 (44%). In males, age groups 0.3 and 0.4 accounted for 82% of the escapement. In females, age groups 0.3 and 0.4 accounted for 78% of the escapement. Overall, females made up 43% of the total escapement (Figure 3). Throughout the season, males were the majority of the escapement, never falling below 52%, except in strata 8 and 9 (Appendix 3). Mean length of males was

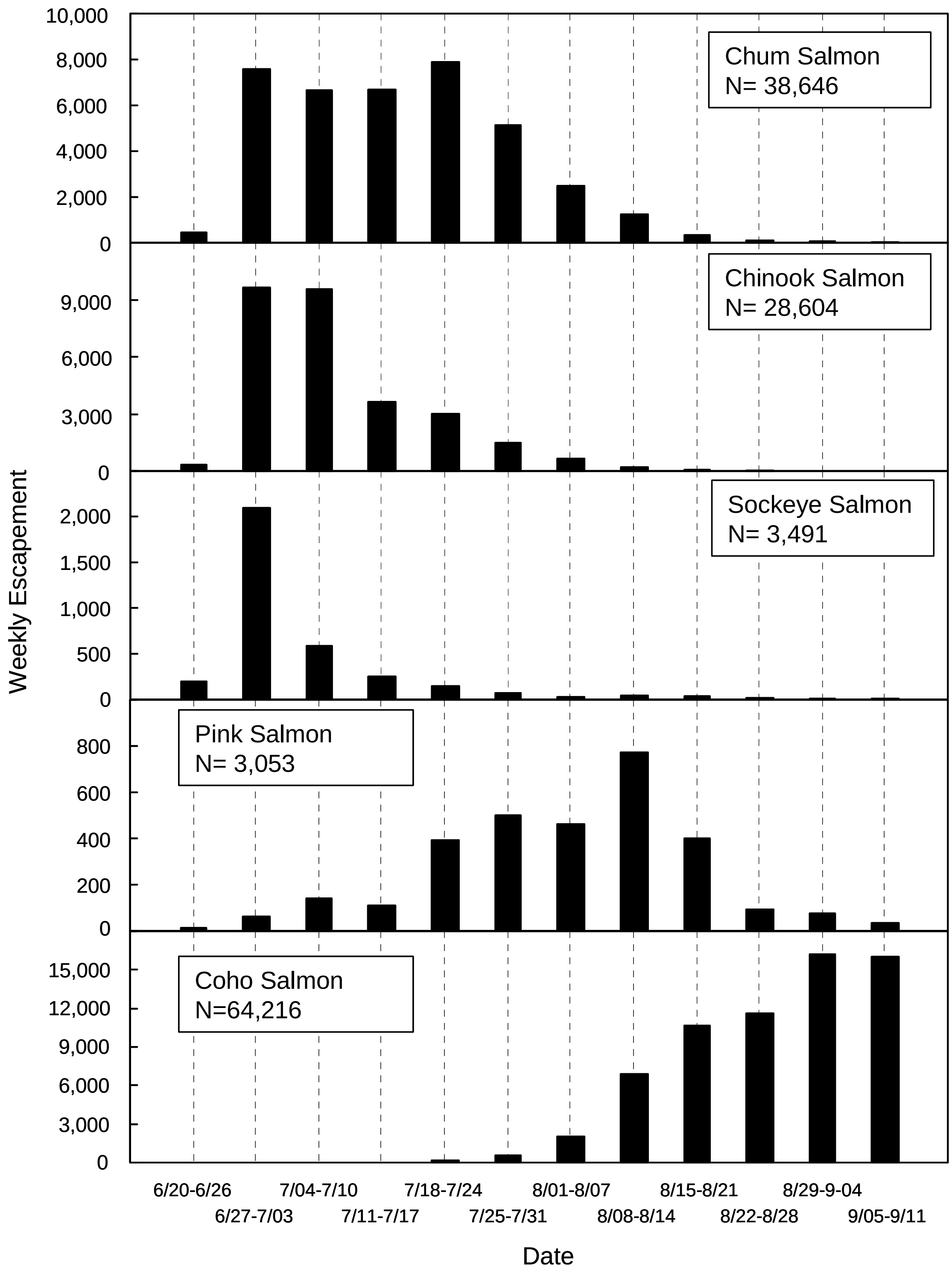

FIGURE 2. Weekly passage of chum, Chinook, sockeye, pink, and coho salmon at the Kwethluk River weir, Alaska, 2004.

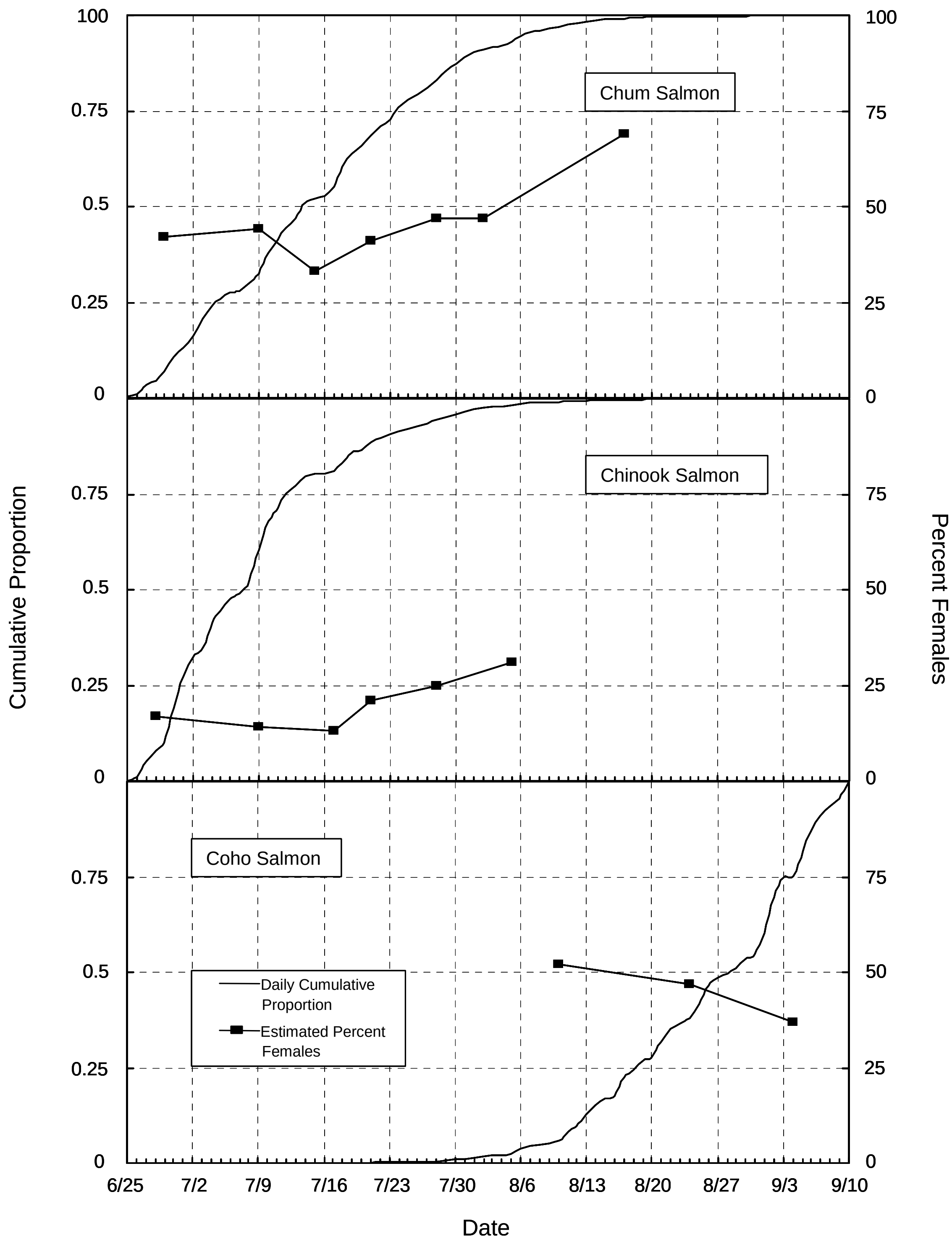

FIGURE 3. Daily cumulative proportion of escapement and percentage of females by week for chum, Chinook, and coho salmon at the Kwethluk River weir, Alaska, 2004.

greater than that of females for all age groups with data sufficient for analysis (Appendix 4, Appendix 5).

Chum salmon carcasses were first recorded on June 27. Median-cumulative passage dates for escaping chum salmon and for chum salmon carcasses washing onto the weir were separated by 20 days. A total of 3,565 carcasses were passed downstream over the weir between June 27 and September 10.

Chinook Salmon - A total of 28,604 Chinook salmon passed through the weir from June 25 to September 9, 2004. Peak-weakly passage (N = 9,624) occurred during the week of June 27 to July 3 (Figure 2). Median-cumulative passage occurred on July 8 (Appendix 2). Gillnet marks were observed on 2% (N = 542) of the Chinook salmon passing through the weir.

Seven age groups were identified from scale samples (1.1, 1.2, 1.3, 2.2, 1.4, 1.5, 2.4). For males, the predominant age group was 1.2 (67%). For females, the predominant age group was 1.4 (87%). In males, age groups 1.2 and 1.3 accounted for 93% of the escapement. In females, age groups 1.3 and 1.4 accounted for 96% of the escapement. Overall, females made up 17% of the escapement (Figure 3). Throughout the season, males were the majority of the escapement, never falling below 69% in any sampling stratum (Appendix 6). Mean length of females was greater than that of males for all age groups with sufficient data for analysis (Appendix 5, Appendix 7).

Chinook salmon carcasses were first recorded on June 27. Median-cumulative passage dates for escaping Chinook salmon and for Chinook salmon carcasses washing onto the weir were separated by 34 days. A total of 1,418 carcasses were passed downstream over the weir between June 27 and September 5.

Sockeye Salmon - A total of 3,491 sockeye salmon passed through the weir from June 25 to September 10, 2004. Peak-weekly passage (N = 2,099) occurred during the week of June 27 to July 3 (Figure 2). Median-cumulative passage occurred on July 1 (Appendix 2). Gillnet marks were observed on 1% (N = 51) of the sockeye salmon passing through the weir.

Sockeye salmon carcasses were first recorded on July 14. Median-cumulative passage dates for escaping sockeye salmon and for sockeye salmon carcasses washing onto the weir were separated by 56 days. A total of 49 carcasses were passed downstream over the weir between July 14 and September 9.

Pink Salmon - A total of 3,053 pink salmon passed through the weir from June 25 to September 10, 2004. Peak-weekly passage (N = 771) occurred during the week of August 8 to August 14 (Figure 2). Median-cumulative passage occurred on August 6 (Appendix 2). Gillnet marks were observed on less than 1% (N = 10) of pink salmon passing through the weir.

Pink salmon carcasses were first recorded on July 19. Median-cumulative passage dates for escaping pink salmon and for pink salmon carcasses washing onto the weir were separated by 10 days. A total of 997 carcasses were passed downstream over the weir between July 19 and September 10.

Coho Salmon - A total of 64,216 coho salmon passed through the weir from July 8 to September 10, 2004. Peak-weekly passage (N = 16,208) occurred during the week of August 29 to

September 4 (Figure 2). Median-cumulative passage occurred on August 29 (Appendix 2). Gillnet marks were observed on 2% (N = 1,050) of coho salmon passing through the weir.

Three age groups were identified from scales (1.1, 2.1, 3.1). For both males and females age 2.1 was the predominant group, making up 93% and 92% of the sample, respectively. Overall, females made up 43% of the escapement and were the majority in stratum 8 (Figure 3, Appendix 8). Mean lengths for ages 1.1 and 2.1 were essentially the same for males and females with males longer at age 3.1. However, the samples were composed of only 2 fish for each sex at age 3.1 and were not analyzed (Appendix 5, Appendix 8).

Coho salmon carcasses were first recorded on August 12. Median-cumulative passage dates for escaping coho salmon and for coho salmon carcasses washing onto the weir were separated by 6 days. A total of 164 carcasses were passed downstream over the weir between August 12 and September 10.

Resident Species

In addition to the returning salmon 245 Dolly Varden *Salvelinus malma*, 423 whitefish *Coregonis spp.*, 3 northern pike *Esox lucius*, 28 Arctic grayling *Thymallus arcticus*, and 71 rainbow trout *Oncorhynchus mykiss* were counted through the weir.

Mark-Recapture Tag Recovery

Eleven tagged salmon were observed at the weir between July 8 and August 26. These consisted of two Chinook, three chum and six sockeye salmon.

Discussion

Weir Operations

In accordance with the current operational plan, aerial surveys were conducted during April to determine when the weir site was clear of ice and water levels were sufficiently low to allow installation of the weir. Installing the weir in April avoids the annual high water event which begins in May and can continue until August depending upon air temperature, snowpack, and rainfall. Past high-water events prevented weir operations entirely in 1991 and precluded weir installation until August 12 in 2001.

Picket spacing on the weir is such that smaller pink salmon and resident species are able to pass, uncounted, between pickets. Other salmon species are effectively blocked. Thus, counts of pink salmon and resident species are below actual passage.

The Kwethluk River weir has had full seasons of operation in 1992, 2000, 2002, 2003, and 2004. From 1993 to 1999 the weir was not operated due to opposition from the Organized Village of Kwethluk. From 1996 to 1999 AVCP operated a counting tower near the present location of the weir with mixed results due to high and turbid water, and did not gather age, sex, or length samples. In 2001, high water prevented installation of the weir until August 12 and it was operated until September 13.

Due to the age of the weir, repairs are consuming time and resources at an increasing rate. During installation, 12 panels needed repair in order to have enough operational panels to span the river. Approximately 90% of the existing panels have needed some form of repair; 50% have required multiple repairs. Some panels are weakened to the point that a worker walking across them can break through, creating a potentially dangerous situation. Much of the damage is sustained during the period between installation and the beginning of operations when ice and debris pass over the panels. In 2004, about 20% of the panels lost their resistance boards during this time. Additional funding for the repair/replacement of weir panels is required if the weir is to remain fully operational in future years.

Biological Data

The Kuskokwim River Rebuilding Plan remained in effect in 2004 and the subsistence fishing schedule (four days open/three days closed per week) went into effect June 6 for areas downstream of Bogus Creek and June 13 for areas downstream of Chuathbaluk. On June 20 the subsistence fishing restriction was removed and commercial fishing began on June 30. A total of 26 commercial fishing openings occurred during the season. Four openings occurred between June 30 and July 7 harvesting Chinook, chum, and sockeye salmon. The remaining 22 openings occurred between July 28 and September 7, targeting coho salmon. A total of 390 individual permit holders made landings during the season, 28% below the 10-year average (Alaska Department of Fish and Game, 2004).

Chum Salmon - Chum salmon escapement (N = 38,646) was down 8% from 2003 but still the second highest recorded (Appendix 10). Median-cumulative escapement (July 14) was eight days earlier than in 2003, but comparable to that of other years. The proportion of gillnet marked chum salmon observed (1%) is comparable to 2003, and well below other years. The proportion of females (43%) was slightly lower than 2003 continuing the downward trend seen in past years (Table 1) (Harper 1998, Roettiger et al. 2004).

TABLE 1. Median-cumulative passage, percent gillnet marked, and percent female for chum salmon at the Kwethluk river weir, Alaska, 2004.

	1992	2000	2001	2002	2003	2004
Median-Cumulative Passage Date	July 18	July 16	No Data	July 17	July 22	July 14
Percent Gillnet Marked	5%	3%	No Data	3%	<1%	1%
Percent Female	No Data	50%	No Data	47%	44%	43%

Chinook Salmon - Chinook salmon escapement (N = 28,604) was a 98% increase from 2003 and more than three times the average of all previous years (Appendix 10). Median-cumulative escapement (July 8) was three days earlier than 2003 and the earliest recorded, but still comparable to previous years. The proportion of gillnet marked Chinook salmon (2%) was up from 2003, but only slightly and still well below other recorded years. The proportion of females (17%) was down from 2003, continuing the downward trend seen in past years (Table 2)(Harper 1998, Roettiger et al. 2004). The data indicate that females are longer than males at a given age, suggesting that selective harvest by the 20.3 cm (8 in.) gillnets used in the subsistence fishery may play a role in the low proportion of females passing the weir (Appendix 5, Appendix 6). Such selectivity has been seen in other Chinook salmon fisheries (Beamesderfer and Parker 2001).

TABLE 2. Median-cumulative passage date, percent gillnet marked, and percent female for Chinook salmon at the Kwethluk River weir, Alaska, 2004.

	1992	2000	2001	2002	2003	2004
Median-Cumulative Passage Date	July 9	July 13	No Data	July 10	July 11	July 8
Percent Gillnet Marked	10%	4%	No Data	4%	1%	2%
Percent Female	25%	21%	No Data	22%	19%	17%

Sockeye Salmon - The Kwethluk River is not known for having a large run of sockeye salmon. They are harvested mainly as by-catch but are highly regarded as a food fish. Escapement (N = 3,491) in 2004 was the highest recorded and an increase of 19% over the previous year, continuing the trend of, relatively, large escapements (Appendix 10). The percentage of gillnet marked sockeye salmon remained low. The proportion of females was the lowest recorded, but only by 1% (Table 3) (Harper 1998, Roettiger et al. 2004).

TABLE 3. Median-cumulative passage date, percent gillnet marked, and percent female for sockeye salmon at the Kwethluk River weir, Alaska, 2004.

	1992	2000	2001	2002	2003	2004
Median-Cumulative Passage Date	July 18	July 1	No Data	July 11	July 7	July1
Percent Gillnet Marked	10%	3%	No Data	0%	1%	1%
Percent Female	60%	49%	No Data	60%	55%	48%

Pink Salmon - The observed escapement for pink salmon (N = 3,053) is a 62% increase over 2003, and is the largest count since the weir, with wider picket spacing, came into use in 2000 (Appendix 10). Median-cumulative passage occurred five days later than in 2003, but well within the range of previous years. The percentage of gillnet marked pink salmon remained low. Age, sex, and length data were not collected for pink salmon. (Table 4)(Harper 1998, Roettiger et al. 2004).

It was assumed that the wider spacing of the pickets would allow most pink salmon to pass upstream uncounted. Were this to occur, one would expect that the ratio of carcasses washed up on the weir to total count to have increased. The reason for this is that carcasses, or “mortalities”, would have approximately the same odds of washing on to the weir while the in-migrating fish would have a reduced chance of being counted. However, the ratios did not increase and were below 1992 in most years (Table 4). We have only one year (1992) of data from the weir with narrow spaced pickets to compare to, and weather conditions can influence the number of mortalities washed onto the weir, but these data suggest that the counts of pink salmon may be closer to the actual escapement than previously thought.

TABLE 4. Median-cumulative passage date and percent gillnet marked for pink salmon at the Kwethluk River weir, Alaska, 2004.

	1992	2000	2001	2002	2003	2004
Median-Cumulative Passage Date	Aug.13	Aug. 4	No Data	July 25	Aug. 1	Aug. 6
Percent Gillnet Marked	<1%	2%	No Data	<1%	<1%	1%
Mortality/Count Ratio	0.32	0.15	No Data	0.14	0.24	0.33

Coho Salmon - The escapement of coho salmon (N = 64,216) was a decrease of 40% from 2003, but still the second highest recorded (Appendix 10). However, this figure is regarded as incomplete because daily counts averaged in excess of 2,500 for the six days prior to the cessation of operations. A similar situation occurred in 2003, so the median passage dates reported for those two years are probably earlier than the actual date. The proportion of gillnet marked coho salmon (2%) was up slightly from 2003, but consistent with previous years observations. The proportion of females (43%) is equal to the lowest recorded at the weir. It should be noted that results for 2001 may be skewed due to small sample sizes (Table 5) (Harper 1998, Roettiger et al. 2002, Roettiger et al. 2004).

TABLE 5. Median-cumulative passage date, percent gillnet-marked, and percent female for coho salmon at the Kwethluk River weir, Alaska, 2004.

	1992	2000	2001	2002	2003	2004
Median-Cumulative Passage Date	Aug. 26	Aug. 21	Aug. 25	Aug. 28	Aug. 29	Aug. 29
Percent Gillnet Marked	3%	2%	2%	1%	<1%	2%
Percent Female	43%	45%	51%	45%	51%	43%

Brood Year 2000 Contribution

This year marked the first year that returns from a previous monitored year's escapement (2000) were a major contributor to escapement of chum, Chinook, and coho salmon (Appendix 10). For each species, the number of adults returning in 2004, which had been spawned in 2000, exceeded the escapement of the brood year. The ratio of returning spawners was higher for Chinook and coho salmon, which spend at least one year in freshwater, than for chum salmon, which migrate to the ocean shortly after emerging from the substrate. The ratio reported for coho salmon is below the actual ratio because weir operations ceased before the end of the run (Table 6).

TABLE 6. Brood year 2000 count, estimated percent contribution to 2004, estimated return, and ratio of year 2000 escapement to 2004 returns for chum, Chinook, and coho salmon at the Kwethluk River weir.

	2000 Count	% Contribution to 2004	Estimated Return	Ratio
Chum Salmon	11,691	42%	16,231	1:1.4
Chinook Salmon	3,547	56%	16,018	1:4.5
Coho Salmon	25,610	92%	59,078	1:2.3

Mark-Recapture Tag Recovery

The two tagged Chinook, three tagged chum, and six tagged sockeye salmon are comparable to 2003 observations (four, one, and two, respectively). The exception is coho, which were not observed at the weir in 2004. From these observations, it appears that the number of fish that move upstream before dropping back down to the Kwethluk River, remains consistent between years. However, the question of whether these are strays or returning to their natal streams remains unanswered.

Recommendations

The Kwethluk River weir continues to be an important tool for monitoring salmon stocks originating on the Yukon Delta National Wildlife Refuge and providing information to the Alaska Department of Fish and Game and Federal In-Season Subsistence Fishery Manager for management of the Lower Kuskokwim River fisheries. It is recommended that the weir project continue to be operated on a yearly basis. It is further recommended that operations be continued into September to get as complete a count of coho salmon as possible. Early installation, prior to spring runoff, is also recommended. To fulfill these recommendations, the existing weir will need extensive repairs or replacement. Therefore, it is recommended that the funding necessary to repair or replace existing weir be made a priority.

Acknowledgements

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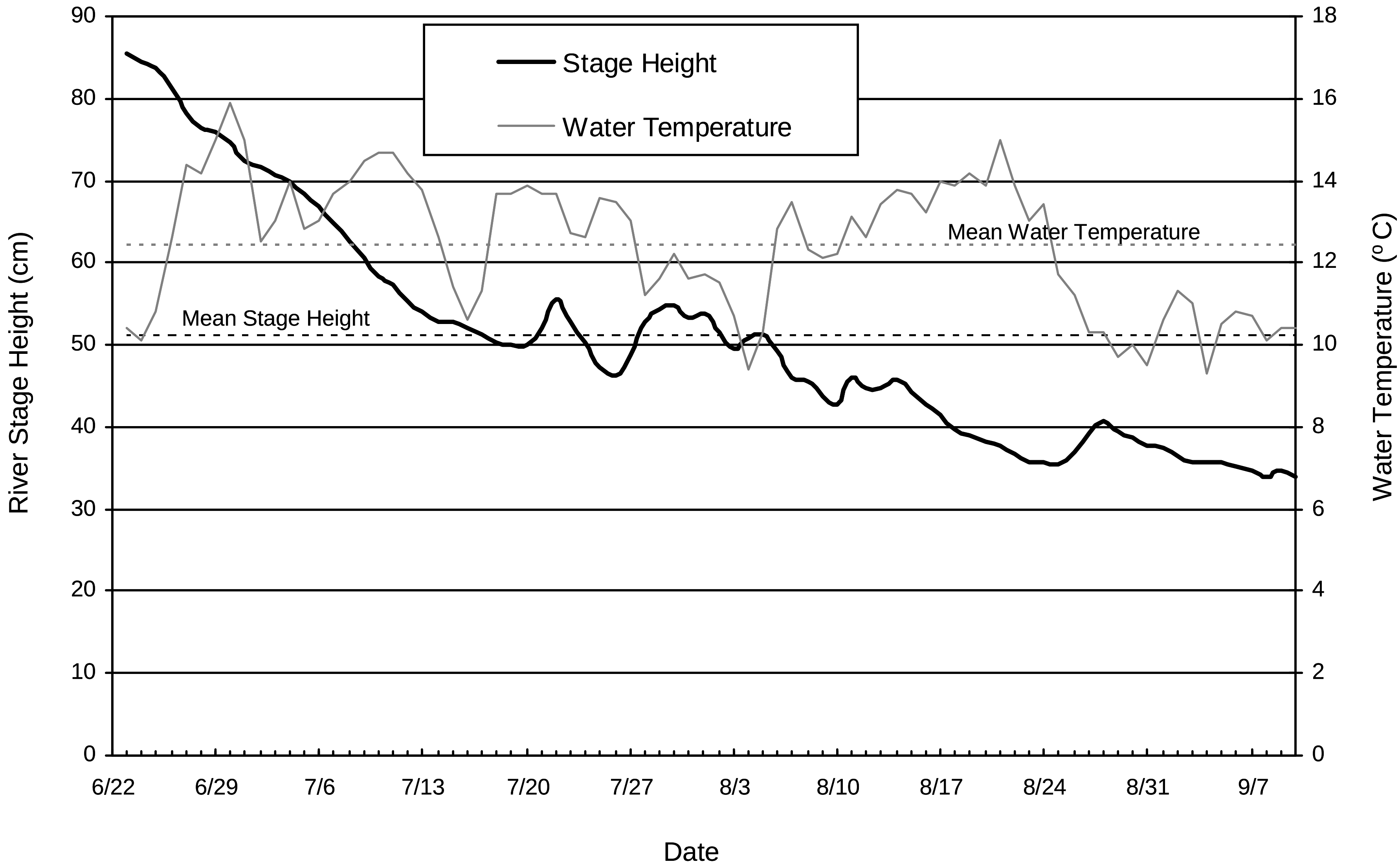

APPENDIX 1. River stage height and water temperature at the Kwethluk River weir, Alaska, 2004.

APPENDIX 2. Daily counts, cumulative counts, and cumulative proportions of chum, Chinook, sockeye, pink, and coho salmon escapement through the Kwethluk River weir, Alaska, 2004. Highlighted areas indicate days when estimates of missed passage were generated.

Date	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
6/25	124	124	0.003	41	41	0.001	105	105	0.030	8	8	0.003	0	0	0.000
6/26	311	435	0.011	286	327	0.011	92	197	0.056	5	13	0.004	0	0	0.000
6/27	886	1,321	0.034	1,201	1,528	0.053	453	650	0.186	5	18	0.006	0	0	0.000
6/28	468	1,789	0.046	794	2,322	0.081	302	952	0.273	0	18	0.006	0	0	0.000
6/29	932	2,721	0.070	538	2,860	0.100	289	1,241	0.356	0	18	0.006	0	0	0.000
6/30	1,385	4,106	0.106	2,600	5,460	0.191	483	1,724	0.494	3	21	0.007	0	0	0.000
7/1	929	5,035	0.130	2,314	7,774	0.272	164	1,888	0.541	4	25	0.008	0	0	0.000
7/2	1,168	6,203	0.161	1,483	9,257	0.324	224	2,112	0.605	16	41	0.013	0	0	0.000
7/3	1,811	8,014	0.207	694	9,951	0.348	184	2,296	0.658	33	74	0.024	0	0	0.000
7/4	1,246	9,260	0.240	1,853	11,804	0.413	152	2,448	0.701	42	116	0.038	0	0	0.000
7/5	705	9,965	0.258	896	12,700	0.444	74	2,522	0.723	11	127	0.041	0	0	0.000
7/6	688	10,653	0.276	921	13,621	0.476	101	2,623	0.752	12	139	0.045	0	0	0.000
7/7	197	10,850	0.281	339	13,960	0.488	15	2,638	0.756	2	141	0.046	0	0	0.000
7/8	771	11,621	0.301	1,008	14,968	0.523	22	2,660	0.762	9	150	0.049	8	8	0.000
7/9	873	12,494	0.323	2,326	17,294	0.605	92	2,752	0.789	27	177	0.058	5	13	0.000
7/10	2,185	14,679	0.380	2,195	19,489	0.681	129	2,881	0.825	40	217	0.071	0	13	0.000
7/11	1,323	16,002	0.414	947	20,436	0.714	75	2,956	0.847	33	250	0.082	0	13	0.000
7/12	1,149	17,151	0.444	1,043	21,479	0.751	49	3,005	0.861	22	272	0.089	0	13	0.000
7/13	938	18,089	0.468	643	22,122	0.773	38	3,043	0.872	24	296	0.097	0	13	0.000
7/14	1,603	19,692	0.510	652	22,774	0.796	58	3,101	0.889	22	318	0.104	0	13	0.000
7/15	410	20,102	0.520	161	22,935	0.802	10	3,111	0.891	7	325	0.106	0	13	0.000
7/16	241	20,343	0.526	43	22,978	0.803	8	3,119	0.894	0	325	0.106	0	13	0.000
7/17	1,019	21,362	0.553	156	23,134	0.809	11	3,130	0.897	3	328	0.107	0	13	0.000
7/18	2,035	23,397	0.605	659	23,793	0.832	37	3,167	0.907	53	381	0.125	16	29	0.000
7/19	1,237	24,634	0.637	806	24,599	0.860	33	3,200	0.917	41	422	0.138	13	42	0.001
7/20	886	25,520	0.660	196	24,795	0.867	14	3,214	0.921	42	464	0.152	12	54	0.001
7/21	1,013	26,533	0.687	523	25,318	0.885	39	3,253	0.932	32	496	0.162	18	72	0.001
7/22	953	27,486	0.711	371	25,688	0.898	18	3,272	0.937	62	557	0.183	37	109	0.002
7/23	629	28,115	0.728	258	25,946	0.907	5	3,277	0.939	71	628	0.206	20	129	0.002
7/24	1,147	29,262	0.757	192	26,138	0.914	3	3,280	0.940	91	719	0.236	42	171	0.003
7/25	808	30,070	0.778	248	26,386	0.922	15	3,295	0.944	94	813	0.266	50	221	0.003

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APPENDIX 2. (Page 2 of 3)

Date	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
7/26	599	30,669	0.794	139	26,525	0.927	7	3,302	0.946	38	851	0.279	28	249	0.004
7/27	671	31,340	0.811	181	26,706	0.934	6	3,308	0.948	41	892	0.292	17	266	0.004
7/28	806	32,146	0.832	319	27,025	0.945	15	3,323	0.952	58	950	0.311	78	344	0.005
7/29	844	32,990	0.854	237	27,262	0.953	7	3,330	0.954	93	1,043	0.342	105	449	0.007
7/30	770	33,760	0.874	168	27,430	0.959	11	3,341	0.957	83	1,126	0.369	157	606	0.009
7/31	647	34,407	0.890	192	27,622	0.966	11	3,352	0.960	92	1,218	0.399	152	758	0.012
8/1	537	34,944	0.904	195	27,817	0.972	7	3,359	0.962	85	1,303	0.427	169	927	0.014
8/2	298	35,242	0.912	74	27,891	0.975	6	3,365	0.964	36	1,339	0.439	182	1,109	0.017
8/3	153	35,395	0.916	79	27,970	0.978	2	3,367	0.964	26	1,365	0.447	86	1,195	0.019
8/4	187	35,582	0.921	65	28,035	0.980	2	3,369	0.965	20	1,385	0.454	83	1,278	0.020
8/5	366	35,948	0.930	65	28,100	0.982	4	3,373	0.966	61	1,446	0.474	352	1,630	0.025
8/6	531	36,479	0.944	96	28,196	0.986	6	3,379	0.968	125	1,571	0.515	845	2,475	0.039
8/7	401	36,880	0.954	72	28,268	0.988	0	3,379	0.968	109	1,680	0.550	352	2,827	0.044
8/8	165	37,045	0.959	31	28,299	0.989	5	3,384	0.969	64	1,744	0.571	180	3,007	0.047
8/9	225	37,270	0.964	12	28,311	0.990	4	3,388	0.970	51	1,795	0.588	396	3,403	0.053
8/10	188	37,458	0.969	21	28,332	0.990	4	3,392	0.972	49	1,844	0.604	227	3,630	0.057
8/11	269	37,727	0.976	32	28,364	0.992	9	3,401	0.974	174	2,018	0.661	1,731	5,361	0.083
8/12	162	37,889	0.980	37	28,401	0.993	7	3,408	0.976	155	2,173	0.712	810	6,171	0.096
8/13	133	38,022	0.984	40	28,441	0.994	5	3,413	0.978	138	2,311	0.757	1,933	8,104	0.126
8/14	101	38,123	0.986	41	28,482	0.996	8	3,421	0.980	140	2,451	0.803	1,590	9,694	0.151
8/15	95	38,218	0.989	12	28,494	0.996	3	3,424	0.981	76	2,527	0.828	1,105	10,799	0.168
8/16	43	38,261	0.990	8	28,502	0.996	2	3,426	0.981	17	2,544	0.833	422	11,221	0.175
8/17	53	38,314	0.991	21	28,523	0.997	4	3,430	0.983	101	2,645	0.866	3,094	14,315	0.223
8/18	55	38,369	0.993	16	28,539	0.998	7	3,437	0.985	75	2,720	0.891	1,443	15,758	0.245
8/19	40	38,409	0.994	17	28,556	0.998	5	3,442	0.986	52	2,772	0.908	1,499	17,257	0.269
8/20	32	38,441	0.995	7	28,563	0.999	2	3,444	0.987	22	2,794	0.915	519	17,776	0.277
8/21	30	38,471	0.995	9	28,572	0.999	13	3,457	0.990	57	2,851	0.934	2,598	20,374	0.317
8/22	28	38,499	0.996	6	28,578	0.999	3	3,460	0.991	27	2,878	0.943	2,268	22,642	0.353
8/23	12	38,511	0.997	6	28,584	0.999	3	3,463	0.992	12	2,890	0.947	801	23,443	0.365
8/24	16	38,527	0.997	2	28,586	0.999	2	3,465	0.993	13	2,903	0.951	1,041	24,484	0.381
8/25	12	38,539	0.997	2	28,588	0.999	1	3,466	0.993	14	2,917	0.955	2,386	26,870	0.418

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APPENDIX 2. (Page 3 of 3)

Date	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
8/26	8	38,547	0.997	3	28,591	1.000	3	3,469	0.994	11	2,928	0.959	2,912	29,782	0.464
8/27	7	38,554	0.998	1	28,592	1.000	4	3,473	0.995	7	2,935	0.961	1,494	31,276	0.487
8/28	4	38,558	0.998	3	28,595	1.000	0	3,473	0.995	10	2,945	0.965	715	31,991	0.498
8/29	9	38,567	0.998	3	28,598	1.000	0	3,473	0.995	10	2,955	0.968	912	32,903	0.512
8/30	14	38,581	0.998	0	28,598	1.000	1	3,474	0.995	10	2,965	0.971	1,328	34,231	0.533
8/31	15	38,596	0.999	1	28,599	1.000	4	3,478	0.996	12	2,977	0.975	1,025	35,256	0.549
9/1	5	38,601	0.999	1	28,600	1.000	0	3,478	0.996	10	2,987	0.978	3,494	38,750	0.603
9/2	12	38,613	0.999	0	28,600	1.000	2	3,480	0.997	21	3,008	0.985	6,006	44,756	0.697
9/3	8	38,621	0.999	0	28,600	1.000	2	3,482	0.997	10	3,018	0.989	3,201	47,957	0.747
9/4	0	38,621	0.999	0	28,600	1.000	1	3,483	0.998	2	3,020	0.989	242	48,199	0.751
9/5	7	38,628	1.000	1	28,601	1.000	0	3,483	0.998	12	3,032	0.993	4,225	52,424	0.816
9/6	7	38,635	1.000	1	28,602	1.000	1	3,484	0.998	6	3,038	0.995	3,332	55,756	0.868
9/7	5	38,640	1.000	0	28,602	1.000	1	3,485	0.998	4	3,042	0.996	2,836	58,592	0.912
9/8	3	38,643	1.000	1	28,603	1.000	3	3,488	0.999	3	3,045	0.997	1,438	60,030	0.935
9/9	2	38,645	1.000	1	28,604	1.000	2	3,490	1.000	2	3,047	0.998	1,357	61,387	0.956
9/10	1	38,646	1.000	0	28,604	1.000	1	3,491	1.000	6	3,053	1.000	2,829	64,216	1.000

APPENDIX 3. Estimated age and sex composition of weekly chum salmon escapements through the Kwethluk River weir, Alaska, 2004, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	Total
Stratum 1:	6/20-6/26					
No Samples Collected						
Stratum 2:	6/27-7/3					
Sampling Dates:	6/28-6/29					
Female:	Number in Sample:	0	24	61	1	86
	Estimated % of Escapement:	0.0	11.7	29.8	0.5	42.0
	Estimated Escapement:	0	873	2,218	36	3,127
	Standard Error:	0.0	165.5	235.3	35.9	
Male:	Number in Sample:	1	30	88	0	119
	Estimated % of Escapement:	0.5	14.6	42.9	0.0	58.0
	Estimated Escapement:	36	1,091	3,200	0	4,328
	Standard Error:	35.9	181.9	254.8	0.0	
Total:	Number in Sample:	1	54	149	1	205
	Estimated % of Escapement:	0.5	26.3	72.7	0.5	100.0
	Estimated Escapement:	36	1,964	5,419	36	7,455
	Standard Error:	35.9	226.7	229.4	35.9	
Stratum 3:	7/4-7/10					
Sampling Dates:	7/7-7/9					
Female:	Number in Sample:	8	36	33	0	77
	Estimated % of Escapement:	4.6	20.6	18.9	0.0	44.0
	Estimated Escapement:	305	1,371	1,257	0	2,933
	Standard Error:	104.1	201.5	195.0	0.0	
Male:	Number in Sample:	9	43	46	0	98
	Estimated % of Escapement:	5.1	24.6	26.3	0.0	56.0
	Estimated Escapement:	343	1,638	1,752	0	3,732
	Standard Error:	110.1	214.7	219.5	0.0	
Total:	Number in Sample:	17	79	79	0	175
	Estimated % of Escapement:	9.7	45.1	45.1	0.0	100.0
	Estimated Escapement:	647	3,009	3,009	0	6,665
	Standard Error:	147.7	248.1	248.1	0.0	
Stratum 4:	7/11-7/17					
Sampling Dates:	7/15					
Female:	Number in Sample:	9	31	17	0	57
	Estimated % of Escapement:	5.1	17.7	9.7	0.0	32.6
	Estimated Escapement:	344	1,184	649	0	2,177
	Standard Error:	110.4	190.9	148.1	0.0	
Male:	Number in Sample:	20	57	41	0	118
	Estimated % of Escapement:	11.4	32.6	23.4	0.0	67.4
	Estimated Escapement:	764	2,177	1,566	0	4,506
	Standard Error:	159.1	234.3	211.8	0.0	
Total:	Number in Sample:	29	88	58	0	175
	Estimated % of Escapement:	16.6	50.3	33.1	0.0	100.0
	Estimated Escapement:	1,107	3,361	2,215	0	6,683
	Standard Error:	185.9	250.0	235.3	0.0	

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APPENDIX 3. (Page 2 of 3)

		Brood Year and Age Group				
		2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	Total
Stratum 5:	7/18-7/24					
Sampling Dates:	7/20-7/21					
Female:	Number in Sample:	20	39	12	0	71
	Estimated % of Escapement:	11.6	22.5	6.9	0.0	41.0
	Estimated Escapement:	913	1,781	548	0	3,242
	Standard Error:	190.5	248.9	151.4	0.0	
Male:	Number in Sample:	24	44	34	0	102
	Estimated % of Escapement:	13.9	25.4	19.7	0.0	59.0
	Estimated Escapement:	1,096	2,009	1,553	0	4,658
	Standard Error:	205.9	259.4	236.7	0.0	
Total:	Number in Sample:	44	83	46	0	173
	Estimated % of Escapement:	25.4	48.0	26.6	0.0	100.0
	Estimated Escapement:	2,009	3,790	2,101	0	7,900
	Standard Error:	259.4	297.6	263.2	0.0	
Stratum 6:	7/25-7/31					
Sampling Dates:	7/26					
Female:	Number in Sample:	29	38	16	0	83
	Estimated % of Escapement:	16.5	21.6	9.1	0.0	47.2
	Estimated Escapement:	848	1,111	468	0	2,426
	Standard Error:	141.8	157.3	109.9	0.0	
Male:	Number in Sample:	30	39	24	0	93
	Estimated % of Escapement:	17.0	22.2	13.6	0.0	52.8
	Estimated Escapement:	877	1,140	702	0	2,719
	Standard Error:	143.7	158.7	131.2	0.0	
Total:	Number in Sample:	59	77	40	0	176
	Estimated % of Escapement:	33.5	43.8	22.7	0.0	100.0
	Estimated Escapement:	1,725	2,251	1,169	0	5,145
	Standard Error:	180.4	189.6	160.2	0.0	
Stratum 7:	8/1-8/7					
Sampling Dates:	8/2					
Female:	Number in Sample:	37	27	18	0	82
	Estimated % of Escapement:	21.1	15.4	10.3	0.0	46.9
	Estimated Escapement:	523	382	254	0	1,159
	Standard Error:	73.8	65.3	54.9	0.0	
Male:	Number in Sample:	42	34	17	0	93
	Estimated % of Escapement:	24.0	19.4	9.7	0.0	53.1
	Estimated Escapement:	594	480	240	0	1,314
	Standard Error:	77.2	71.5	53.5	0.0	
Total:	Number in Sample:	79	61	35	0	175
	Estimated % of Escapement:	45.1	34.9	20.0	0.0	100.0
	Estimated Escapement:	1,116	862	495	0	2,473
	Standard Error:	89.9	86.1	72.3	0.0	

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APPENDIX 3. (Page 3 of 3)

		Brood Year and Age Group				
		2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	Total
Strata 8 & 9:	8/8-8/21					
Sampling Dates:	8/9-8/10 & 8/16-8/17					
Female:	Number in Sample:	80	64	14	0	158
	Estimated % of Escapement:	34.8	27.8	6.1	0.0	68.7
	Estimated Escapement:	553	443	97	0	1,093
	Standard Error:	46.3	43.6	23.2	0.0	
Male:	Number in Sample:	29	27	16	0	72
	Estimated % of Escapement:	12.6	11.7	7.0	0.0	31.3
	Estimated Escapement:	201	187	111	0	498
	Standard Error:	32.3	31.3	24.7	0.0	
Total:	Number in Sample:	109	91	30	0	230
	Estimated % of Escapement:	47.4	39.6	13.0	0.0	100.0
	Estimated Escapement:	754	629	208	0	1,591
	Standard Error:	48.6	47.5	32.7	0.0	
Strata 10-12:	8/22-9/11					
No Samples Collected						
Strata 1-12:	6/20-9/11					
Sampling Dates:	6/28-8/17					
Female:	Number in Sample:	183	259	171	1	614
	% Females in Age Group:	21.6	44.2	34.0	0.2	100.0
	Estimated % of Escapement:	9.2	18.8	14.5	0.1	42.6
	Estimated Escapement:	3,486	7,144	5,491	36	16,157
	Standard Error:	295.0	444.2	392.3	35.9	
	Estimated Design Effects:	0.980	1.208	1.163	1.256	1.199
Male:	Number in Sample:	155	274	266	0	695
	% Males in Age Group:	18.0	40.1	41.9	0.0	100.0
	Estimated % of Escapement:	10.3	23.0	24.1	0.0	57.4
	Estimated Escapement:	3,910	8,722	9,123	0	21,755
	Standard Error:	329.8	482.4	484.4	0.0	
	Estimated Design Effects:	1.103	1.229	1.201	0.000	1.199
Total:	Number in Sample:	338	533	437	1	1,309
	Estimated % of Escapement:	19.5	41.8	38.5	0.1	100.0
	Estimated Escapement:	7,396	15,866	14,614	36	37,912 *
	Standard Error:	409.8	556.5	520.4	35.9	
	Estimated Design Effects:	1.004	1.192	1.070	1.256	

*734 fish that were counted through the weir during stratum 1 & 10-12 are not included in this total.

APPENDIX 4. Estimated length (mm) at age composition of weekly chum salmon escapements through the Kwethluk River weir, Alaska, 2004.

		Brood Year and Age Group			
		2001	2000	1999	1998
		0.2	0.3	0.4	0.5
Stratum 1:	6/20-6/26				
No Samples Collected					
Stratum 2:	6/27-7/3				
Sampling Dates:	6/28-6/29				
Female:	Mean Length		562	572	570
	Std. Error		5	3	
	Range		515- 615	510- 635	
	Sample Size	0	24	61	1
Male:	Mean Length	585	569	597	
	Std. Error		4	3	
	Range		505- 605	515- 670	
	Sample Size	1	30	88	0
Stratum 3:	7/4-7/10				
Sampling Dates:	7/7-7/9				
Female:	Mean Length	528	544	553	
	Std. Error	9	4	4	
	Range	480- 565	480- 590	505- 595	
	Sample Size	8	36	33	0
Male:	Mean Length	551	569	588	
	Std. Error	5	4	5	
	Range	525- 570	535- 640	510- 645	
	Sample Size	9	43	46	0
Stratum 4:	7/11-7/17				
Sampling Dates:	7/15				
Female:	Mean Length	534	550	563	
	Std. Error	4	4	5	
	Range	520- 555	495- 580	520- 610	
	Sample Size	9	31	17	0
Male:	Mean Length	545	567	588	
	Std. Error	5	4	3	
	Range	505- 585	500- 630	545- 625	
	Sample Size	20	57	41	0
Stratum 5:	7/18-7/24				
Sampling Dates:	7/20-7/21				
Female:	Mean Length	529	544	557	
	Std. Error	3	5	7	
	Range	500- 560	465- 625	520- 610	
	Sample Size	20	39	12	0
Male:	Mean Length	545	568	582	
	Std. Error	5	4	5	
	Range	495- 580	505- 640	510- 635	
	Sample Size	24	44	34	0

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APPENDIX 4. (Page 2 of 2)

		Brood Year and Age Group			
		2001	2000	1999	1998
		0.2	0.3	0.4	0.5
Stratum 6:	7/25-7/31				
Sampling Dates:	7/26				
Female:	Mean Length	528	547	561	
	Std. Error	4	5	8	
	Range	485- 565	485- 610	495- 605	
	Sample Size	29	38	16	0
Male:	Mean Length	544	567	591	
	Std. Error	4	5	8	
	Range	510- 585	495- 635	500- 640	
	Sample Size	30	39	24	0
Stratum 7:	8/1-8/7				
Sampling Dates:	8/2				
Female:	Mean Length	520	546	537	
	Std. Error	4	6	6	
	Range	475- 565	490- 615	495- 585	
	Sample Size	37	27	18	0
Male:	Mean Length	539	565	593	
	Std. Error	4	5	7	
	Range	475- 605	505- 660	530- 640	
	Sample Size	42	34	17	0
Strata 8 & 9:	8/8-8/21				
Sampling Dates:	8/9-8/10 & 8/16-8/17				
Female:	Mean Length	518	532	544	
	Std. Error	2	3	8	
	Range	475- 570	470- 615	480- 595	
	Sample Size	80	64	14	0
Male:	Mean Length	540	555	561	
	Std. Error	4	6	9	
	Range	495- 585	500- 620	495- 625	
	Sample Size	29	27	16	0
Strata 10-12:	8/22-9/11				
No Samples Collected					
Strata 1-12:*	6/20-9/11				
Sampling Dates:	6/28-8/17				
Female:	Mean Length	522	544	559	570
	Std. Error	1	2	2	
	Range	475- 570	465- 625	480- 635	
	Sample Size	183	259	171	1
Male:	Mean Length	543	566	589	
	Std. Error	2	2	2	
	Range	475- 605	495- 660	495- 670	
	Sample Size	155	274	266	0

* Includes strata 1 & 10-12 during which no samples were collected.

APPENDIX 5. Results for t-tests (assuming unequal variance) for difference in mean length-at-age between male and female fish, for age classes with sufficient data for analysis, for chum, Chinook, and coho salmon at the Kwethluk River weir, Alaska, 2004.

Chum Salmon

Age	0.2		0.3		0.4	
	Male	Female	Male	Female	Male	Female
Mean Length (mm)	543	522	566	544	589	559
Variance	552	426	777	818	891	773
Observations	155	183	274	259	267	172
Hypothesized Mean Difference	0		0		0	
df	309		527		383	
t Stat	8.40		8.96		10.61	
P(T<=t) two-tail	< 0.01		< 0.01		< 0.01	
t Critical two-tail	1.97		1.96		1.97	

Chinook Salmon

Age	1.3		1.4	
	Male	Female	Male	Female
Mean Length (mm)	691	813	807	871
Variance	3666	1420	9500	2621
Observations	257	34	58	175
Hypothesized Mean Difference	0		0	
df	59		68	
t Stat	-16.39		-4.77	
P(T<=t) two-tail	< 0.01		< 0.01	
t Critical two-tail	2.00		2.00	

Coho Salmon

Age	1.1		2.1	
	Male	Female	Male	Female
Mean Length (mm)	541	543	559	559
Variance	1305	258	1635	822
Observations	5	5	95	76
Hypothesized Mean Difference	0		0	
df	6		167	
t Stat	-0.11		-0.07	
P(T<=t) two-tail	0.91		0.94	
t Critical two-tail	2.45		1.97	

APPENDIX 6. Estimated age and sex composition of weekly Chinook salmon escapements through the Kwethluk River weir, Alaska, 2004, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group								
		2001	2000	1999		1998		1997		
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
Stratum 1:	6/20-6/26									
No Samples Collected										
Stratum 2:	6/27-7/3									
Sampling Dates:	6/28-6/29									
Female:	Number in Sample:	0	0	2	0	31	0	0	0	33
	Estimated % of Escapement:	0.0	0.0	1.0	0.0	15.6	0.0	0.0	0.0	16.6
	Estimated Escapement:	0	0	97	0	1,499	0	0	0	1,596
	Standard Error:	0.0	0.0	67.5	0.0	245.5	0.0	0.0	0.0	
Male:	Number in Sample:	2	122	34	0	8	0	0	0	166
	Estimated % of Escapement:	1.0	61.3	17.1	0.0	4.0	0.0	0.0	0.0	83.4
	Estimated Escapement:	97	5,900	1,644	0	387	0	0	0	8,028
	Standard Error:	67.5	329.7	254.8	0.0	133.0	0.0	0.0	0.0	
Total:	Number in Sample:	2	122	36	0	39	0	0	0	199
	Estimated % of Escapement:	1.0	61.3	18.1	0.0	19.6	0.0	0.0	0.0	100.0
	Estimated Escapement:	97	5,900	1,741	0	1,886	0	0	0	9,624
	Standard Error:	67.5	329.7	260.5	0.0	268.7	0.0	0.0	0.0	
Stratum 3:	7/4-7/10									
Sampling Dates:	7/7-7/9									
Female:	Number in Sample:	0	0	1	0	27	0	1	0	29
	Estimated % of Escapement:	0.0	0.0	0.5	0.0	13.4	0.0	0.5	0.0	14.4
	Estimated Escapement:	0	0	47	0	1,275	0	47	0	1,369
	Standard Error:	0.0	0.0	46.7	0.0	226.5	0.0	46.7	0.0	
Male:	Number in Sample:	1	109	49	0	14	0	0	0	173
	Estimated % of Escapement:	0.5	54.0	24.3	0.0	6.9	0.0	0.0	0.0	85.6
	Estimated Escapement:	47	5,147	2,314	0	661	0	0	0	8,169
	Standard Error:	46.7	331.8	285.3	0.0	169.0	0.0	0.0	0.0	
Total:	Number in Sample:	1	109	50	0	41	0	1	0	202
	Estimated % of Escapement:	0.5	54.0	24.8	0.0	20.3	0.0	0.5	0.0	100.0
	Estimated Escapement:	47	5,147	2,361	0	1,936	0	47	0	9,538
	Standard Error:	46.7	331.8	287.3	0.0	267.7	0.0	46.7	0.0	
Stratum 4:	7/11-7/17									
Sampling Dates:	7/15-7/17									
Female:	Number in Sample:	0	0	2	0	21	0	2	0	25
	Estimated % of Escapement:	0.0	0.0	1.1	0.0	11.1	0.0	1.1	0.0	13.2
	Estimated Escapement:	0	0	39	0	405	0	39	0	482
	Standard Error:	0.0	0.0	26.5	0.0	81.4	0.0	26.5	0.0	
Male:	Number in Sample:	0	108	47	0	8	0	1	0	164
	Estimated % of Escapement:	0.0	57.1	24.9	0.0	4.2	0.0	0.5	0.0	86.8
	Estimated Escapement:	0	2,083	906	0	154	0	19	0	3,163
	Standard Error:	0.0	128.1	111.9	0.0	52.1	0.0	18.8	0.0	
Total:	Number in Sample:	0	108	49	0	29	0	3	0	189
	Estimated % of Escapement:	0.0	57.1	25.9	0.0	15.3	0.0	1.6	0.0	100.0
	Estimated Escapement:	0	2,083	945	0	559	0	58	0	3,645
	Standard Error:	0.0	128.1	113.4	0.0	93.3	0.0	32.4	0.0	

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APPENDIX 6. (Page 2 of 3)

		Brood Year and Age Group								
		2001	2000	1999		1998		1997		
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
Stratum 5:	7/18-7/24									
Sampling Dates:	7/20-7/21									
Female:	Number in Sample:	0	0	8	0	30	0	2	0	40
	Estimated % of Escapement:	0.0	0.0	4.1	0.0	15.5	0.0	1.0	0.0	20.7
	Estimated Escapement:	0	0	125	0	467	0	31	0	623
	Standard Error:	0.0	0.0	41.8	0.0	76.0	0.0	21.2	0.0	
Male:	Number in Sample:	1	98	44	0	9	0	1	0	153
	Estimated % of Escapement:	0.5	50.8	22.8	0.0	4.7	0.0	0.5	0.0	79.3
	Estimated Escapement:	16	1,526	685	0	140	0	16	0	2,382
	Standard Error:	15.1	104.9	88.0	0.0	44.2	0.0	15.1	0.0	
Total:	Number in Sample:	1	98	52	0	39	0	3	0	193
	Estimated % of Escapement:	0.5	50.8	26.9	0.0	20.2	0.0	1.6	0.0	100.0
	Estimated Escapement:	16	1,526	810	0	607	0	47	0	3,005
	Standard Error:	15.1	104.9	93.1	0.0	84.2	0.0	26.0	0.0	
Stratum 6:	7/25-7/31									
Sampling Dates:	7/26-7/28									
Female:	Number in Sample:	0	0	11	0	31	0	2	1	45
	Estimated % of Escapement:	0.0	0.0	6.0	0.0	16.8	0.0	1.1	0.5	24.5
	Estimated Escapement:	0	0	89	0	250	0	16	8	363
	Standard Error:	0.0	0.0	24.3	0.0	38.4	0.0	10.6	7.5	
Male:	Number in Sample:	1	77	49	2	10	0	0	0	139
	Estimated % of Escapement:	0.5	41.8	26.6	1.1	5.4	0.0	0.0	0.0	75.5
	Estimated Escapement:	8	621	395	16	81	0	0	0	1,121
	Standard Error:	7.5	50.7	45.4	10.6	23.3	0.0	0.0	0.0	
Total:	Number in Sample:	1	77	60	2	41	0	2	1	184
	Estimated % of Escapement:	0.5	41.8	32.6	1.1	22.3	0.0	1.1	0.5	100.0
	Estimated Escapement:	8	621	484	16	331	0	16	8	1,484
	Standard Error:	7.5	50.7	48.1	10.6	42.7	0.0	10.6	7.5	
Stratum 7:	8/1-8/7									
Sampling Dates:	8/2-8/5									
Female:	Number in Sample:	0	1	9	0	29	0	3	0	42
	Estimated % of Escapement:	0.0	0.7	6.6	0.0	21.2	0.0	2.2	0.0	30.7
	Estimated Escapement:	0	5	42	0	137	0	14	0	198
	Standard Error:	0.0	4.2	12.2	0.0	20.1	0.0	7.2	0.0	
Male:	Number in Sample:	2	62	22	1	8	0	0	0	95
	Estimated % of Escapement:	1.5	45.3	16.1	0.7	5.8	0.0	0.0	0.0	69.3
	Estimated Escapement:	9	292	104	5	38	0	0	0	448
	Standard Error:	5.9	24.5	18.1	4.2	11.5	0.0	0.0	0.0	
Total:	Number in Sample:	2	63	31	1	37	0	3	0	137
	Estimated % of Escapement:	1.5	46.0	22.6	0.7	27.0	0.0	2.2	0.0	100.0
	Estimated Escapement:	9	297	146	5	174	0	14	0	646
	Standard Error:	5.9	24.5	20.6	4.2	21.8	0.0	7.2	0.0	

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APPENDIX 6. (Page 3 of 3).

		Brood Year and Age Group								
		2001	2000	1999		1998		1997		
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4	Total
Stratum 8:	8/8-8/14									
Sampling Dates:	8/9-8/11									
Female:	Number in Sample:	0	0	1	0	6	0	2	0	9
	Estimated % of Escapement:	0.0	0.0	2.1	0.0	12.5	0.0	4.2	0.0	18.8
	Estimated Escapement:	0	0	4	0	27	0	9	0	40
	Standard Error:	0.0	0.0	3.9	0.0	9.1	0.0	5.5	0.0	
Male:	Number in Sample:	1	25	12	0	1	0	0	0	39
	Estimated % of Escapement:	2.1	52.1	25.0	0.0	2.1	0.0	0.0	0.0	81.3
	Estimated Escapement:	4	111	54	0	4	0	0	0	174
	Standard Error:	3.9	13.7	11.9	0.0	3.9	0.0	0.0	0.0	
Total:	Number in Sample:	1	25	13	0	7	0	2	0	48
	Estimated % of Escapement:	2.1	52.1	27.1	0.0	14.6	0.0	4.2	0.0	100.0
	Estimated Escapement:	4	111	58	0	31	0	9	0	214
	Standard Error:	3.9	13.7	12.2	0.0	9.7	0.0	5.5	0.0	
Strata 9-12:	8/15-9/11									
No Samples Collected										
Strata 1-12:	6/20-9/11									
Sampling Dates:	6/28-8/11									
Female:	Number in Sample:	0	1	34	0	175	0	12	1	223
	% Females in Age Group:	0.0	0.1	9.5	0.0	86.9	0.0	3.3	0.2	100.0
	Estimated % of Escapement:	0.0	0.0	1.6	0.0	14.4	0.0	0.6	0.0	16.6
	Estimated Escapement:	0	5	443	0	4,060	0	156	8	4,671
	Standard Error:	0.0	4.2	99.7	0.0	354.8	0.0	59.4	7.5	
	Estimated Design Effects:	0.000	0.193	0.974	0.000	1.522	0.000	0.970	0.330	1.461
Male:	Number in Sample:	8	601	257	3	58	0	2	0	929
	% Males in Age Group:	0.8	66.8	26.0	0.1	6.2	0.0	0.1	0.0	100.0
	Estimated % of Escapement:	0.6	55.7	21.7	0.1	5.2	0.0	0.1	0.0	83.4
	Estimated Escapement:	181	15,680	6,102	21	1,465	0	35	0	23,485
	Standard Error:	84.1	499.5	411.2	11.4	227.2	0.0	24.1	0.0	
	Estimated Design Effects:	1.645	1.509	1.487	0.298	1.560	0.000	0.721	0.000	1.461
Total:	Number in Sample:	8	602	291	3	233	0	14	1	1,152
	Estimated % of Escapement:	0.6	55.7	23.2	0.1	19.6	0.0	0.7	0.0	100.0
	Estimated Escapement:	181	15,685	6,545	21	5,525	0	191	8	28,156 *
	Standard Error:	84.1	499.5	418.1	11.4	402.6	0.0	64.0	7.5	
	Estimated Design Effects:	1.645	1.509	1.463	0.298	1.533	0.000	0.924	0.330	

*449 fish that were counted through the weir during strata 1 and 9-12 are not included in this total.

APPENDIX 7. Estimated length (mm) at age composition of weekly Chinook salmon escapements through the Kwethluk River weir, Alaska, 2004.

		Brood Year and Age Group							
		2001	2000	1999		1998		1997	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
Stratum 1:	6/20-6/26								
No Samples Collected									
Stratum 2:	6/27-7/3								
Sampling Dates:	6/28-6/29								
Female:	Mean Length			793		880			
	Std. Error			8		5			
	Range			785- 800		825- 940			
	Sample size	0	0	2	0	31	0	0	0
Male:	Mean Length	480	586	666		823			
	Std. Error	15	3	7		25			
	Range	465- 495	485- 670	590- 775		740- 900			
	Sample size	2	122	34	0	8	0	0	0
Stratum 3:	7/4-7/10								
Sampling Dates:	7/7-7/9								
Female:	Mean Length			795		865		905	
	Std. Error					9			
	Range					775- 945			
	Sample size	0	0	1	0	27	0	1	0
Male:	Mean Length	430	588	686		775			
	Std. Error		5	9		30			
	Range		455- 680	595- 875		525- 920			
	Sample size	1	108	49	0	14	0	0	0
Stratum 4:	7/11-7/17								
Sampling Dates:	7/15-7/17								
Female:	Mean Length			803		864		915	
	Std. Error			18		13		35	
	Range			785- 820		735- 960		880- 950	
	Sample size	0	0	2	0	21	0	2	0
Male:	Mean Length		589	685		787		700	
	Std. Error		4	10		44			
	Range		485- 700	525- 810		520- 940			
	Sample size	0	108	47	0	8	0	1	0
Stratum 5:	7/18-7/24								
Sampling Dates:	7/20-7/21								
Female:	Mean Length			833		858		880	
	Std. Error			14		9		20	
	Range			770- 880		720- 945		860- 900	
	Sample size	0	0	8	0	30	0	2	0
Male:	Mean Length	530	595	707		789		670	
	Std. Error		5	9		40			
	Range		500- 755	595- 850		560- 965			
	Sample size	1	98	44	0	9	0	1	0

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APPENDIX 7. (Page 2 of 2)

		Brood Year and Age Group							
		2001	2000	1999		1998		1997	
		1.1	1.2	1.3	2.2	1.4	2.3	1.5	2.4
Stratum 6:	7/25-7/31								
Sampling Dates:	7/26-7/28								
Female:	Mean Length			790		871		938	845
	Std. Error			7		12		23	
	Range			760- 825		720- 985		915- 960	
	Sample size	0	0	11	0	31	0	2	1
Male:	Mean Length	500	590	704	590	834			
	Std. Error		5	8	50	18			
	Range		485- 690	595- 790	540- 640	730- 900			
	Sample size	1	77	49	2	10	0	0	0
Stratum 7:	8/1-8/7								
Sampling Dates:	8/2-8/5								
Female:	Mean Length		940	829		878		878	
	Std. Error			14		8		29	
	Range			760- 870		805- 965		830- 930	
	Sample size	0	1	9	0	29	0	3	0
Male:	Mean Length	513	587	686	630	853			
	Std. Error	18	6	15		31			
	Range	495- 530	455- 685	525- 825		735- 980			
	Sample size	2	62	22	1	8	0	0	0
Stratum 8:	8/8-8/14								
Sampling Dates:	8/9-8/11								
Female:	Mean Length			850		903		845	
	Std. Error					29		15	
	Range					775- 990		830- 860	
	Sample size	0	0	1	0	6	0	2	0
Male:	Mean Length	515	584	694		820			
	Std. Error		10	22					
	Range		465- 660	550- 775					
	Sample size	1	25	12	0	1	0	0	0
Strata 9-12:	8/15-9/11								
No Samples Collected									
Strata 1-12:*	6/20-9/12								
Sampling Dates:	6/28-8/11								
Female:	Mean Length		940	809		871		900	845
	Std. Error			6		4		15	
	Range			760- 880		720- 990		830- 960	
	Sample size	0	1	34	0	175	0	12	1
Male:	Mean Length	475	588	684	599	796		687	
	Std. Error	14	2	4	50	16			
	Range	430- 530	455- 755	525- 875	540- 640	520- 980		670- 700	
	Sample size	8	600	257	3	58	0	2	0

* Includes Strata 1 & 9-12 during which no samples were collected.

APPENDIX 8. Estimated age and sex composition of weekly coho salmon escapements through the Kwethluk River weir, Alaska, 2004, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group			
		2001	2000	1999	
		1.1	2.1	3.1	Total
Strata 1-7:	6/20-8/7				
No Samples Collected					
Stratum 8:	8/8-8/14				
Sampling Dates:	8/9-8/10				
Female:	Number in Sample:	1	28	2	31
	Estimated % of Escapement:	1.7	46.7	3.3	51.7
	Estimated Escapement:	114	3,205	229	3,548
	Standard Error:	113.9	444.1	159.8	
Male:	Number in Sample:	1	28	0	29
	Estimated % of Escapement:	1.7	46.7	0.0	48.3
	Estimated Escapement:	114	3,205	0	3,319
	Standard Error:	113.9	444.1	0.0	
Total:	Number in Sample:	2	56	2	60
	Estimated % of Escapement:	3.3	93.3	3.3	100.0
	Estimated Escapement:	229	6,409	229	6,867
	Standard Error:	159.8	222.0	159.8	
Stratum 9:	8/15-8/21				
No Samples Collected					
Stratum 10:	8/22-8/28				
Sampling Dates:	8/24				
Female:	Number in Sample:	2	27	0	29
	Estimated % of Escapement:	3.2	43.5	0.0	46.8
	Estimated Escapement:	375	5,059	0	5,434
	Standard Error:	262.1	735.5	0.0	
Male:	Number in Sample:	1	30	2	33
	Estimated % of Escapement:	1.6	48.4	3.2	53.2
	Estimated Escapement:	187	5,621	375	6,183
	Standard Error:	186.9	741.3	262.1	
Total:	Number in Sample:	3	57	2	62
	Estimated % of Escapement:	4.8	91.9	3.2	100.0
	Estimated Escapement:	562	10,680	375	11,617
	Standard Error:	318.3	403.9	262.1	
Stratum 11:	8/29-9/4				
Sampling Dates:	9/4				
Female:	Number in Sample:	2	21	0	23
	Estimated % of Escapement:	3.2	33.3	0.0	36.5
	Estimated Escapement:	515	5,403	0	5,917
	Standard Error:	360.2	968.5	0.0	
Male:	Number in Sample:	3	37	0	40
	Estimated % of Escapement:	4.8	58.7	0.0	63.5
	Estimated Escapement:	772	9,519	0	10,291
	Standard Error:	437.5	1,011.4	0.0	
Total:	Number in Sample:	5	58	0	63
	Estimated % of Escapement:	7.9	92.1	0.0	100.0
	Estimated Escapement:	1,286	14,922	0	16,208
	Standard Error:	555.3	555.3	0.0	

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APPENDIX 8. (Page 2 of 2)

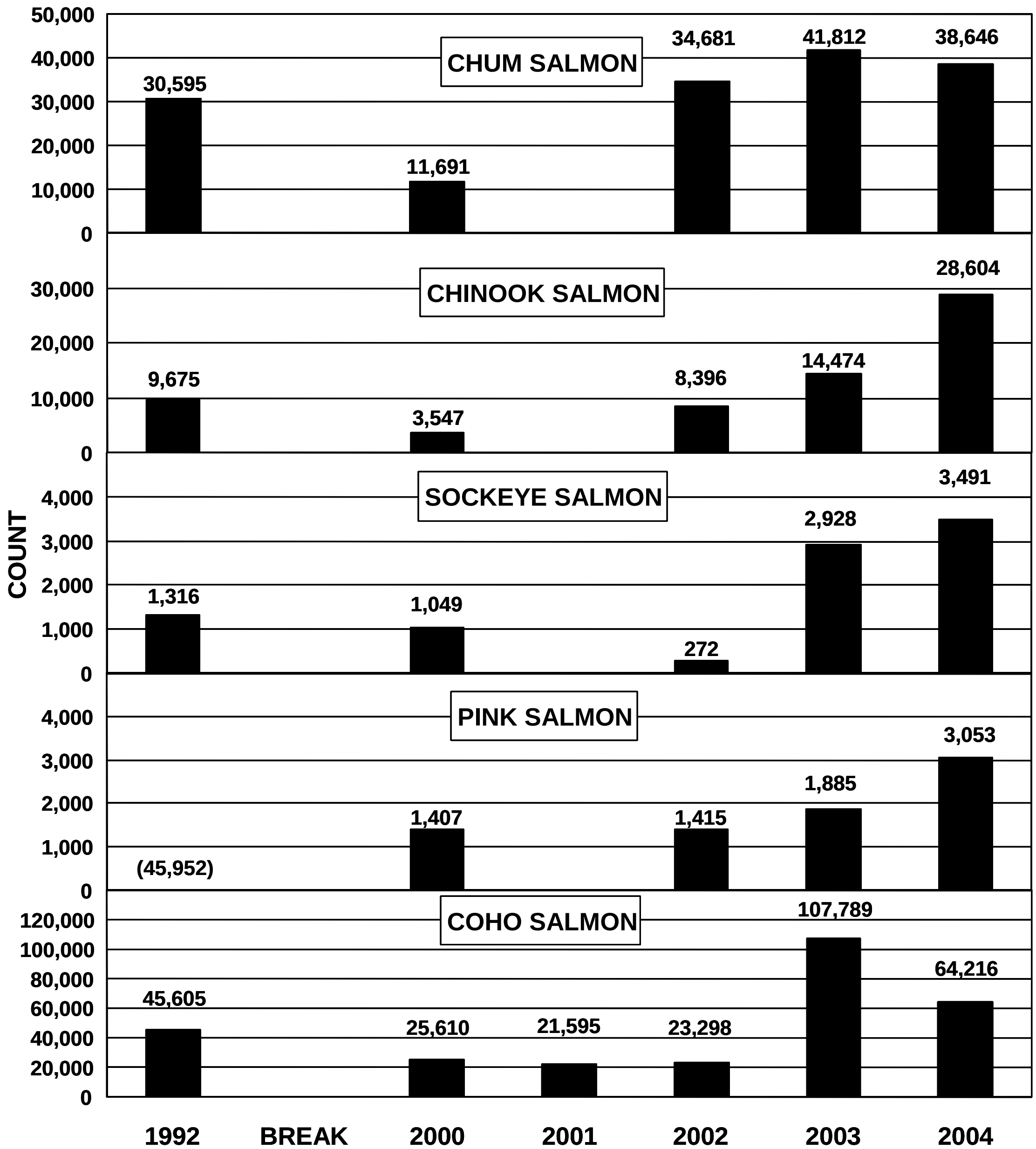
		Brood Year and Age Group			
		2001	2000	1999	
		1.1	2.1	3.1	Total
Stratum 12:	9/5-9/11				
No Samples Collected					
Strata 1-12:	6/20-9/11				
Sampling Dates:	8/9-9/4				
Female:	Number in Sample:	5	76	2	83
	% Females in Age Group:	6.7	91.7	1.5	100.0
	Estimated % of Escapement:	2.9	39.4	0.7	42.9
	Estimated Escapement:	1,004	13,666	229	14,899
	Standard Error:	459.8	1,294.6	159.8	
	Estimated Design Effects:	1.156	1.079	0.601	1.081
Male:	Number in Sample:	5	95	2	102
	% Males in Age Group:	5.4	92.7	1.9	100.0
	Estimated % of Escapement:	3.1	52.9	1.1	57.1
	Estimated Escapement:	1,074	18,345	375	19,793
	Standard Error:	489.2	1,330.3	262.1	
	Estimated Design Effects:	1.225	1.091	0.988	1.081
Total:	Number in Sample:	10	171	4	185
	Estimated % of Escapement:	6.0	92.3	1.7	100.0
	Estimated Escapement:	2,077	32,011	604	34,692 *
	Standard Error:	659.7	721.7	307.0	
	Estimated Design Effects:	1.187	1.122	0.848	

*29,524 fish that were counted through the weir during strat 1-7, 9, &12 are not included in this total.

APPENDIX 9. Estimated length (mm) at age composition of weekly coho salmon escapements through the Kwethluk River weir, Alaska, 3004.

		Brood Year and Age Group		
		2001	2000	1999
		1.1	2.1	3.1
Strata 1-7:	6/20-8/7			
No Samples Collected				
Stratum 8:	8/8-8/14			
Sampling Dates:	8/9-8/10			
Female:	Mean Length	535	551	485
	Std. Error		6	25
	Range		445- 595	460- 510
	Sample Size	1	28	2
Male:	Mean Length	520	554	
	Std. Error		7	
	Range		475- 610	
	Sample Size	1	28	0
Stratum 9:	8/15-8/21			
No Samples Collected				
Stratum 10:	8/22-8/28			
Sampling Dates:	8/24			
Female:	Mean Length	533	564	
	Std. Error	3	6	
	Range	530- 535	505- 615	
	Sample Size	2	27	0
Male:	Mean Length	540	554	585
	Std. Error		8	25
	Range		455- 615	560- 610
	Sample Size	1	30	2
Stratum 11:	8/29-9/4			
Sampling Dates:	9/4			
Female:	Mean Length	558	565	
	Std. Error	13	5	
	Range	545- 570	515- 600	
	Sample Size	2	21	0
Male:	Mean Length	548	566	
	Std. Error	28	7	
	Range	505- 600	440- 630	
	Sample Size	3	37	0
Stratum 12:	9/5-9/11			
No Samples Collected				
Strata 1-12:*	6/20-9/11			
Sampling Dates:	8/9-9/4			
Female:	Mean Length	546	561	485
	Std. Error	7	3	25
	Range	530- 570	445- 615	460- 510
	Sample Size	5	76	2
Male:	Mean Length	544	560	585
	Std. Error	28	4	25
	Range	505- 600	440- 630	560- 610
	Sample Size	5	95	2

* Includes Strata 1-7, 9, and 12 during which no samples were collected.



APPENDIX 10. Annual passage, including estimates of missed passage, of chum, Chinook, sockeye, pink, and coho salmon at the Kwethluk River weir, Alaska, 1992 and 2000 - 2004. Break indicates years when the weir was not operational. In 2001 late installation resulted in insufficient data being collected to estimate passage for all species except coho salmon. Pink salmon counts subsequent to 1992 are assumed to be relative abundance due to wider picket spacing beginning in 2000 (see discussion).